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# CONSTRUCTION SUPPLY CHAIN MANAGEMENT AND ORGANIZATIONAL PERFORMANCE IN CONSTRUCTION PROJECTS

Handge Gauri (P.G.Student), Prof. M.C.Aher (Assistant Professor)

## ABSTRACT

In the present global market, the competition is not between the companies but between the supply chains. Whereas delays are common in construction projects. The occurrence of delays in construction projects are common and significantly affects by various ways. Delays in supply of materials and material shortage are one among the most important factors that causes delay in construction project delivery globally. The critical effects of delay investigated are cost overruns, time overrun, and termination of contract, arbitration, and litigation. Delay management in construction industry is a main factor responsible for delays in construction of project and the growing rate of project delay is directly affecting the timely delivery of construction project.This study evaluates the effect of delay on construction of project and remedial measures to prevent the delay in construction. The aim of this study is to identify the effect of delays on completion of project & time of execution. And find the actual causes of project delay delivery factors which are affect the supply chain management (SCM), then carrying out the quantitative analysis using a questionnaire survey among contractors, engineers and suppliers by using the Relative Importance Index (RII) Method. All factors affecting SCM have been ranked using RII Method using the response acquired respondent.

Keywords: Supply Chain Management, Delay, Relative Important Index, SPSS Software.

## 1. INTRODUCTION

Construction industry in India can be separated into primary three market fragments: Real Estate, Industrial and Infrastructure. And there is a huge venture stream into the infrastructural improvement in India. Construction companies experienced a decrease in productivity and increase in costs. Owners of these firms thought that these increase in cost were due to economic and inflation problems and research explained that was also attributable to poor management. With the expanding worldwide rivalry, Indian firms need to take all the stakeholders of the building supply chain who impact the efficiency of the work of labor. Recently supply chain has become a major subject of management research and manufacturing theory. It has been defined as the network of organizations which are involved through upstream and downstream linkages, in the different processes and activities that produce value in the form of services and products in the hands of the ultimate customer. Currently supply chain management is in its developing stage. In this current scenario to avoid the conflicts and competition among the suppliers a proper supply chain management system is needed. Supply chain management (SCM) has been widely regarded as an effective and efficient management measure and strategy to improve the performance of the construction industry, which has suffered from high fragmentation, large waste, poor productivity, cost and time overruns, and conflicts and disputes for many years. Currently supply chain management is in its developing stage. In this current scenario to avoid the conflicts and competition among the suppliers a proper supply chain management system is needed. It mainly consists of number of participants and complex in their nature.

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The construction sector players including engineers, contractors, suppliers and clients. They have major roles in establishing and developing SCM and collaboration. There are many challenges that are faced by construction industry in India, and the important challenge among them is improper material supply chain in construction. Each and every product that reaches an end user is the cumulative effort of multiple organizations. These organizations refer collectively as a supply chain. Supply chain Network of organizations and business process for procuring materials, transforming raw materials into finished products and distributing the finished products to the customers. Supply chain management is an integration of suppliers, distributors and customer logistics into one cohesive process.

Delays in construction project are considered to be one of the usual problems in the construction industry. These are negative effect on the project with respect to performance, time and cost. Therefore, it is essential to identify the type of delays that usually occur during the construction. This problem not only affects the construction sector but also the economy's growth and the feasible development of nation. Delays in construction can be defined as the late completion of work compared to the contract schedule either planned schedule. Those delays can be minimized only when their causes are known and identified. The reduction of delays can be achieved by applying the process of knowledge management and project learning which gives perception into the various problems and their solutions. In fact, feedbacks from projects are the real eye opener and they are helpful for others to avoid same problems. The identification of various types of delays leads to various reasons of delay. The reasons for the delays are recognized and the effect on construction projects can be reduced. The reasons for delays are contractor and client related. Uncooperative project scope and improper early planning are the prime delays by the client. The objectives of this study is evaluate and identify the effect of delays on project completion & time of execution and find the actual causes of project delay delivery.

### 1.1 Supply Chain Management

'Supply chain' is the term used to describe the linkage of companies that turns a series of basic materials, products and services into a finished product for the client. All construction companies, be they client, main contractor, surveyor, supplier and designer are therefore part of a supply chain. Because of the project based nature of construction and the way that procurement normally operates, they are usually members of different supply chains on different projects. Each company in the chain has a client – the organization to which the services are provided – but an integrated supply chain will have the objective of understanding and working wholly in the interests of the 'project client'. The movement of a product or services from supplier to customer takes place with the help of organization, people, technology and resources. According to Terry & Harrison "a supply chain is a network of facilities and distribution options that perform the functions of procurement of materials, transformation of materials into intermediate and finished products and the distribution of the finished products to customers".

- The benefits for individual companies in the supply chain include:
- Reduced real costs, with margins maintenance
- Incentive to remove waste from the process
- Greater certainty of out-turn costs
- Delivery of better underlying value to the client
- More repeat business with key clients

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## 2. RESEARCH METHODOLOGY

A descriptive research method was adopted in this research by using a well-structured questionnaire for data collection. The data collected to determine the major factors which affect delays in project was done through a survey by explorative questionnaire to the respondents involved in daily activities of construction firms.

The questionnaire was planned and designed so that respondents can give the rank to their answers based on their opinions. The analysis of these data was done by a ranking method named relative importance index (RII) method.

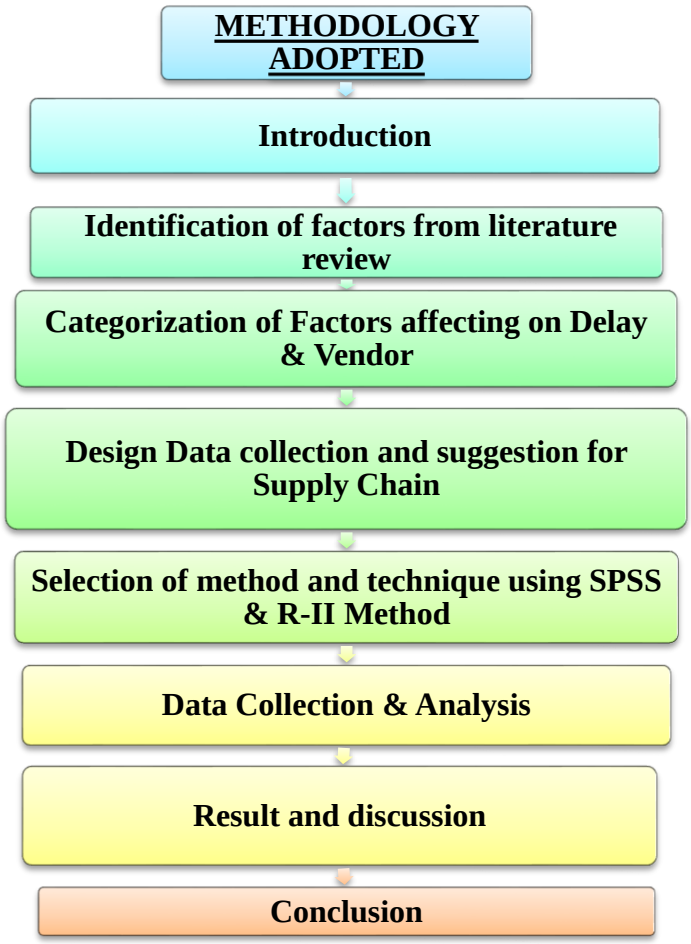


**Figure 2.1: Flow of Methodology**

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# 3. DATA COLLECTION

Data collection was made from various sources. Initially, factors affecting delays in supply chain management were collected through literature review from various research papers. Final survey was done to collect information; the survey form of the questionnaires was distributed to the engineers requested through web survey i.e. Google form. The response to the questionnaire was to be answered in the form of rating of 1-5, where 1 being the not important and 5 being the very important. The questionnaires were distributed through various electronic media platform to a variety of respondent working around the construction projects. About 100 people have responded to the questionnaire survey.

## 3.1 Data Collection:

**Table 3.1 Ranking of factors of working tools and objects**

| Factors | RII | Impact | Ranking |
|---|---|---|---|
| Quality of building materials | 4.25 | Very High | 5 |
| Quality of working tools | 4.01 | High | 4 |
| Complexity of works | 3.72 | Low | 2 |
| Material transport methods | 3.02 | Extreme Low | 1 |

**Table 3.2Ranking of factors that motivate employees**

| Factors | RII | Impact | Ranking |
|---|---|---|---|
| Types of salary payment | 4.27 | Very high | 5 |
| Staff Support | 4.05 | High | 4 |
| Reward Mechanism | 3.69 | High | 4 |
| Spiritual Life | 3.58 | Mid | 3 |
| Training and improving skills | 3.32 | Low | 2 |
| Initiative at work | 3.18 | Extreme low | 1 |

**Table 3.3 Ranking of factors on workers themselves**

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| Factors | RII | Impact | Ranking |
|---|---|---|---|
| Experience of workers | 4.29 | Very high | 5 |
| Labor Discipline | 4.12 | Very high | 5 |
| Physical ability | 4.01 | High | 4 |
| Psychophysiology ability | 3.78 | High | 4 |
| Labor Intensity | 3.52 | Mid | 3 |
| Age | 3.41 | Low | 2 |
| Gender | 3.19 | Extreme Low | 1 |
| Level of training | 3.09 | Extreme Low | 1 |

**Table 3.4 Ranking of operational and managerial factors**

| Factors | RII | Impact | Ranking |
|---|---|---|---|
| Ability to organize production | 4.23 | Very high | 5 |
| Construction supervision | 4.20 | High | 4 |
| Application of technology | 3.92 | Mid | 3 |
| Workers' arrangement | 3.73 | Low | 2 |
| Labor's Communication | 2.89 | Extreme low | 1 |

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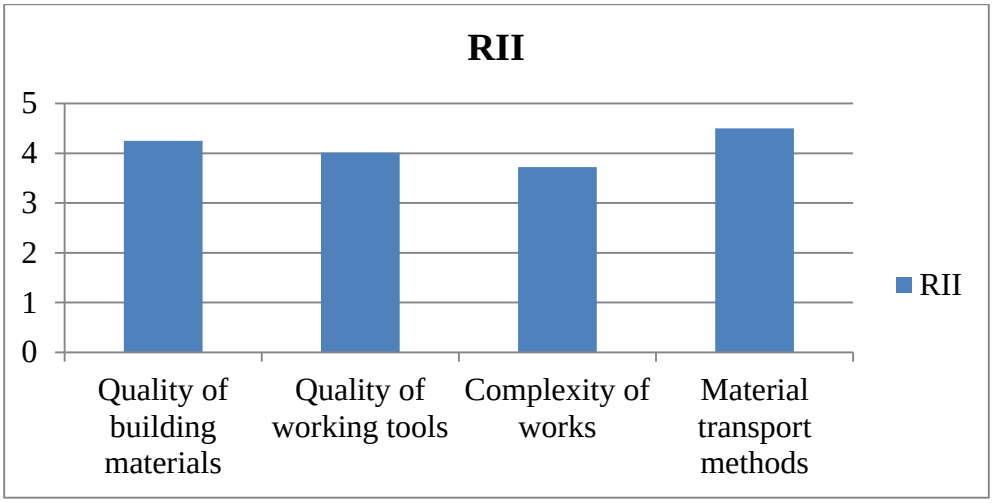
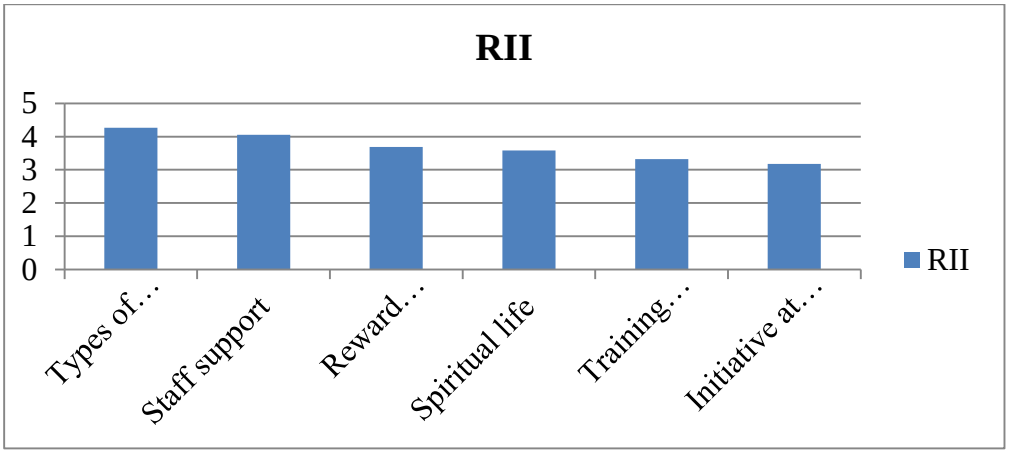
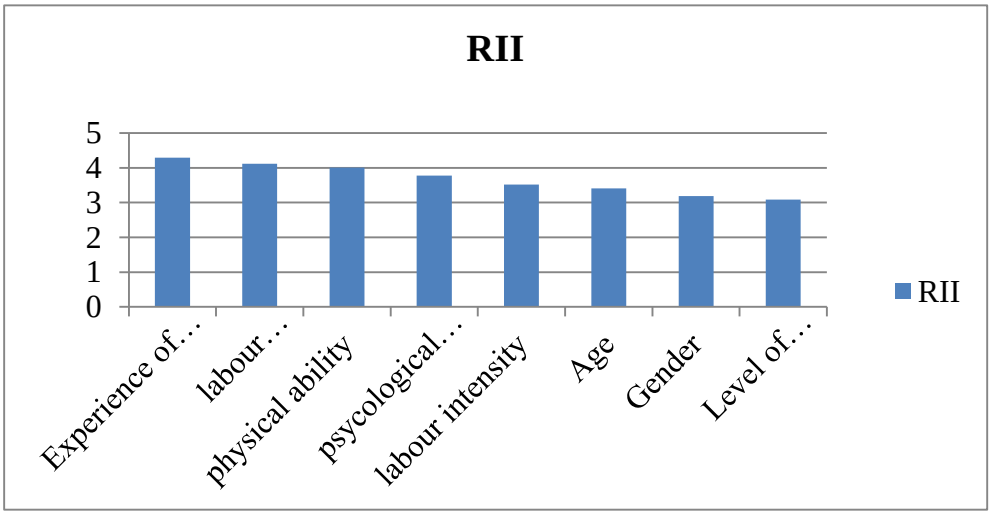
**Graph 3.1 Ranking of factors of working tools and objects**




**Graph 3.2 Ranking of factors that motivate employees**




**Graph 3.3 Ranking of factors on workers themselves**



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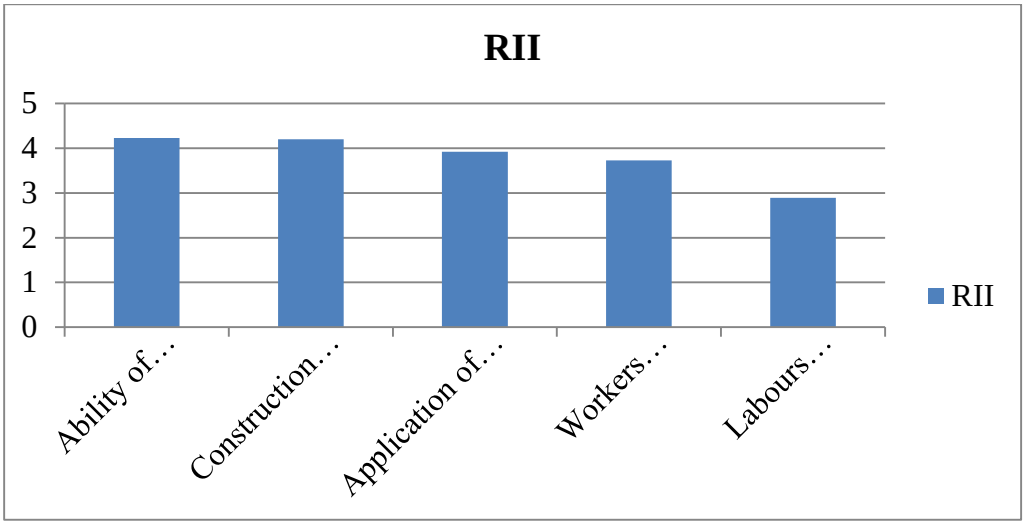
**Graph 3.4 Ranking of operational and managerial factors**




# 4. RESULTS & DISCUSSION

## 4.1 Questionnaire Survey

The questionnaire design practice advanced on a communicating basis. Questions in the respondent profile were created to collect information such as job position, experience of the work, locations of the current and/or previous works and contact information. The responses were to be based on the understanding, knowledge and experience of the respondents and related to particular project.

This simple and straight method was selected to establish a means of developing a list of factors affecting cost. A Five-point scale of 1(Strongly agree) to 5 (Strongly Disagree) was considered for evaluating the impact of each factor.

## 4.2 Pilot Survey and Questionnaire Revision:

To improve the questionnaire section, a pilot study was accompanied. This section contained identification of different causes, collection, and conclusions of data. The application of this section benefited in better formation of the survey development. Total 25 questionnaires, were sent to laborers, contractors, architectures, owners, project managers, valuators and project engineers of various building construction organizations.

## 4.3 SPSS SOFTWARE-

Analysis of the questionnaires survey was done using IBM SPSS Software. SPSS Statistics is a software package used for statistical analysis. The software name originally stood for Statistical Package for the Social Sciences (SPSS), reflecting the original market. It is a Windows based program that can be used to perform data entry and analysis and to create tables and graphs. It is capable of handling large amounts of data and can perform all of the analyses covered in the text and much more. It is a widely used program for statistical analysis in social science. It is also used by market researchers, health researchers, survey companies, government, education researchers, marketing organizations, data miners, and others. All the responses obtained from the questionnaires are entered in to the software. First, the variables or the questions are entered

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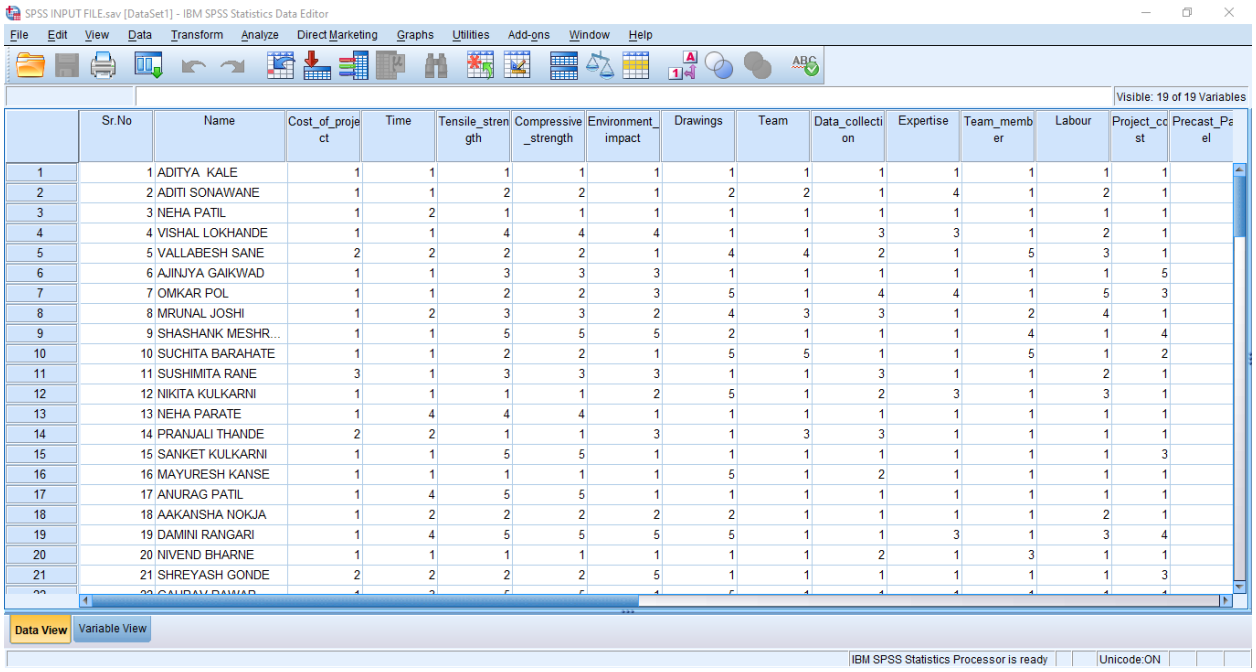
in the data view, then, the responses are entered into the software from the various data entered into the software, frequency can be found which is used to determine the relative importance factor.

**SPSS data View:** The Questioner Survey responses were reported in excel file. After opening data, SPSS displays them in a spread sheet-like fashion as shown in below figure 6. The excel file was export in data View and check the values and other information in spread sheet.




| | Sr.No | Name | Cost_of_project | Time | Tensile_strength | Compressive_strength | Environment_impact | Drawings | Team | Data_collection | Expertise | Team_member | Labour | Project_cost | Precast_Panel |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | ADITYA KALE | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| 2 | 2 | ADITI SONAWANE | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 4 | 1 | 2 | 1 | |
| 3 | 3 | NEHA PATIL | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| 4 | 4 | VISHAL LOKHANDE | 1 | 1 | 4 | 4 | 4 | 1 | 1 | 3 | 3 | 1 | 2 | 1 | |
| 5 | 5 | VALLABESH SANE | 2 | 2 | 2 | 2 | 1 | 4 | 4 | 2 | 1 | 5 | 3 | 1 | |
| 6 | 6 | AJINJYA GAIKWAD | 1 | 1 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 5 | |
| 7 | 7 | OMKAR POL | 1 | 1 | 2 | 2 | 3 | 5 | 1 | 4 | 4 | 1 | 5 | 3 | |
| 8 | 8 | MRUNAL JOSHI | 1 | 2 | 3 | 3 | 2 | 4 | 3 | 3 | 1 | 2 | 4 | 1 | |
| 9 | 9 | SHASHANK MESHR... | 1 | 1 | 5 | 5 | 5 | 2 | 1 | 1 | 1 | 1 | 4 | 1 | |
| 10 | 10 | SUCHITA BARAHATE | 1 | 1 | 2 | 2 | 1 | 5 | 5 | 1 | 1 | 5 | 1 | 2 | |
| 11 | 11 | SUSHIMITA RANE | 3 | 1 | 3 | 3 | 3 | 1 | 1 | 3 | 1 | 1 | 2 | 1 | |
| 12 | 12 | NIKITA KULKARNI | 1 | 1 | 1 | 1 | 2 | 5 | 1 | 2 | 3 | 1 | 3 | 1 | |
| 13 | 13 | NEHA PARATE | 1 | 4 | 4 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| 14 | 14 | PRANJALI THANDE | 2 | 2 | 1 | 1 | 3 | 1 | 3 | 3 | 1 | 1 | 1 | 1 | |
| 15 | 15 | SANKET KULKARNI | 1 | 1 | 5 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | |
| 16 | 16 | MAYURESH KANSE | 1 | 1 | 1 | 1 | 1 | 5 | 1 | 2 | 1 | 1 | 1 | 1 | |
| 17 | 17 | ANURAG PATIL | 1 | 4 | 5 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| 18 | 18 | AAKANSHA NOKJA | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | |
| 19 | 19 | DAMINI RANGARI | 1 | 4 | 5 | 5 | 5 | 5 | 1 | 1 | 3 | 1 | 3 | 4 | |
| 20 | 20 | NIVEND BHARNE | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 3 | 1 | 1 | |
| 21 | 21 | SHREYASH GONDE | 2 | 2 | 2 | 2 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | |

**Figure 4.1: SPSS Data View**

**SPSS Variable View:** An SPSS data file always has a second sheet called variable view. It shows the meta-data associated with the data. Meta-data is information about the meaning of variables and data values. In Variable View, different columns are displayed. Each line corresponds to a variable. A variable is simply a quantity of something, which varies and can be measured, such as height, weight, number of children, educational level, gender and so forth.

**SPSS Data analysis:** SPSS can open all sorts of data and display them and their metadata in two sheets in its Data Editor window. In our data contain a variable holding respondents' on ferrocement related question, we can compute the frequency by navigating to Descriptive Statistics. For better understanding and detailed study pie charts option is also selected.

**SPSS Output Window:** After clicking Ok, a new window opens up, SPSS output viewer window. It holds a nice table with all statistics on all variables we chose. Output Viewer window has a different layout and structure than the Data Editor window we saw earlier. Creating output in SPSS does not change our data in any way; unlike Excel, SPSS uses different windows for data and research outcomes based on those data.

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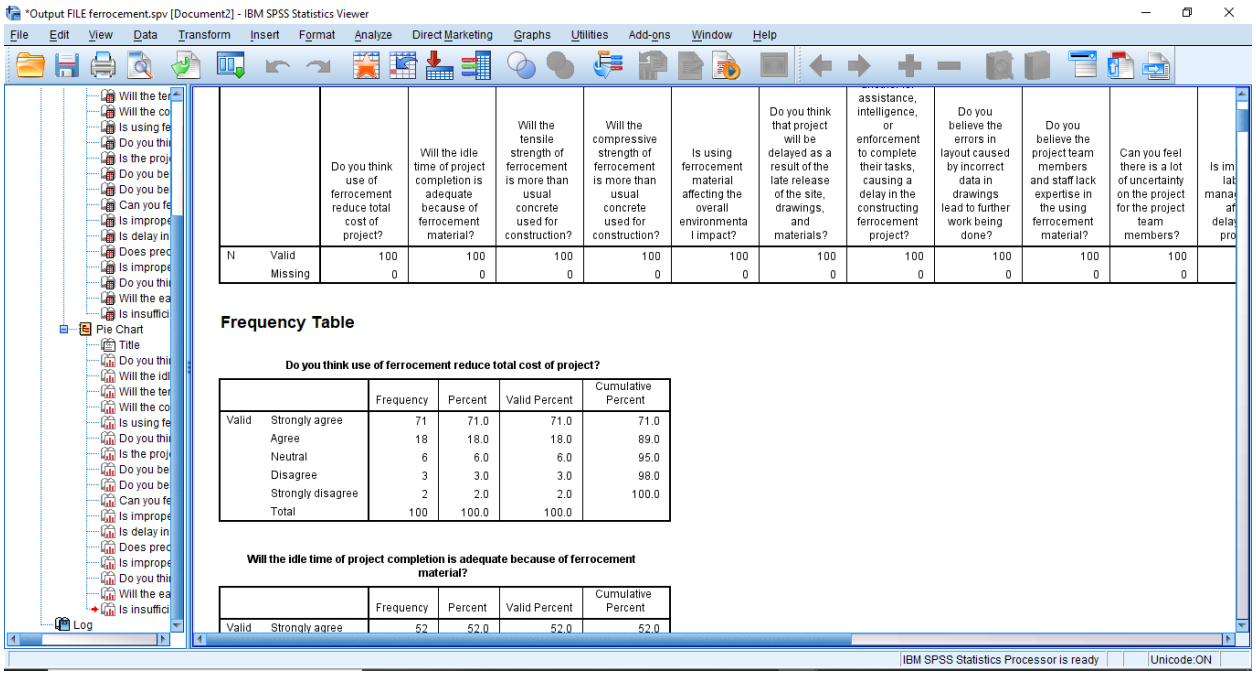


**Figure 4.2: SPSS output window**

Among the many available methods in collecting data two methods were adopted; these are literature review and questionnaires. The first step involves general information collection, including both first-hand and second-hand data, in order to identify major themes from the literature. In the second step, with the literature review and unstructured interviews, important factors of safety were identified. With these factors, a questionnaire was formed and Survey was conducted. The questionnaires were distributed through various electronic media platform to a variety of respondent working around the construction projects. About 100 people have responded to the questionnaire survey.

## 4.4 RII Method

The sample for this study is relatively small. As a result, the analysis had combined all groups of respondents (clients, consultants, contractors and regulatory boards) in order to obtain significant results. Data was analyzed by calculating frequencies and Relative Importance Index (RII).In this project, RII technique approach is used for data analysis. This technique is used to determine the relative importance of the various factors affecting the waste generation working on construction sites. The data analysis was carried out using SPSS software. SPSS was used to generate the frequency (fi) of the response category index for the cause and effect factors. The relative importance index (RII) for each factor was calculated using the frequency data for each response categories generated from SPSS.

Assessment of questionnaire was carried out using three point likert scale from 1 to 5 representing can be not at all, no, most of the times, yes respectively. Data analysis was done calculating Relative Important Index (RII) by following formula. Ranking of the various factors according to their significance, and calculating their Relative Importance Index (RII)

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$RII = \Sigma W / A * N$

Where, W = weight given to each factor by respondents
$\sum W = 5 \times W5 + 4 \times W4 + 3 \times W3 + 2 \times W2 + 1 \times W1$
A = highest weight (i.e. 5)
N = total number of respondents (N=100)

## 5. CONCLUSION

This study includes questionnaires' survey in which we can find out the factor affecting the construction cost which directly related with material use in construction projects. The factors affecting the construction cost and time were identified through the literature based on previous research.

The completion of the project with the mitigation and acceleration has resulted in a cost saving as more delays would have meant that the budget would go out of control. The cost for the works should include additional provisions for subcontractors if the product is likely to come from abroad to take care of any inflation or fluctuations in currency. Nomination of subcontractors has to be done on time to prevent any delays. Due to the delay and project being put on hold, the reputation of the client would be badly affected. Clients should have enough funds to complete a project if a financial crisis affects the system.

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